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ABSTRACT

In spite of massive research efforts, no clear conclusions have been reached with regard to whether specific exceptional groups demonstrate Wechsler Intelligence Scale for Children-Revised (WISC-R) profiles that reliably differentiate them from normative or other exceptional groups. This study applied multivariate clustering and profile analysis procedures to the Kaufman-recategorized WISC-R subtest data of 119 samples of normal and exceptional children drawn from the available WISC-R research literature in an attempt to determine whether some limited number of WISC-R patterns adequately describe the performance of these children and the extent to which such performance patterns may be associated with psychoeducational diagnosis or level of intellect. This meta-exploration showed the performance of the 119 samples to be most parsimoniously described by three relatively distinct recategorized WISC-R profiles. Profile similarity appeared to be most strongly related to the mean Full Scale IQ of the samples. Samples failed to cluster as a function of psychoeducational diagnosis. These results suggest that the use of WISC-R profile analysis for the differentiation of various diagnostic groups is not warranted. Twenty-six pages of bibliographical references as well as data tables are appended. (Author/JAZ)

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A Meta-Exploration of WISC-R Factor Score Profiles as a Function of Diagnosis and Intellectual Level.

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Footnotes

1. The research reported in Mueller, et al. (1984) was actually completed before that reported in Mueller, et al. (1983), however due to publication delays they

were published out of sequence.

Abstract

The analysis of WISC-R subtest patterning has become an increasingly popular aid to the differential diagnosis of children. Characteristic WISC-R performance profiles have been suggested for a number of diverse groups, including the mentally handicapped, the learning disabled, the emotionally disturbed, the delinquent, the intellectually superior, the neurologically impaired, and various ethno-cultural minority groups. But in spite of massive research efforts and the accumulation of a rather extensive literature, no clear conclusions have been reached with regard to whether specific exceptional groups demonstrate WISC-R profiles that reliably differentiate them from normative or other exceptional groups.

This study applied multivariate clustering and profile analysis procedures to the Kaufman-recategorized WISC-R subtest data of 119 samples of normal and exceptional children drawn from the available WISC-R research literature in an attempt to determine whether some limited number of WISC-R patterns adequately describe the performance of these children and the extent to which such performance patterns may be associated with psychoeducational

diagnosis or level of intellect. This meta-exploration showed the performance of the 119 samples to be most parsimoniously described by three relatively distinct recategorized WISC-R profiles. Profile similarity appeared to be most strongly related to the mean Full Scale IQ of the samples. Samples failed to cluster as a function of psychoeducational diagnosis. These results suggest that the use of WISC-R profile analysis for the differentiation of various diagnostic groups is not warranted.

A Meta-Exploration of WISC-R Factor Score Profiles as a Function of Diagnosis and Intellectual Level.

The revised Wechsler Intelligence Scale for Children (Wechsler, 1974) is currently the most popular and well-researched psychometric instrument for the assessment of the intellectual functioning of individual children in both clinical and educational settings (Kaufman, 1979a; Quattrocchi & Sherrets, 1980; Sattler, 1982). To a great extent, the WISC-R's popularity with clinical and educational psychologists has not been due to such exemplary aspects of the instrument as the robust reliability of the WISC-R's three IQ scores with a variety of exceptional populations (Covin, 1977c; Dean, 1977b; Hirshoren, Kavale, Hurley & Hunt, 1977; Larabee & Holroyd, 1976; Vance, Gaynor & Coleman, 1977), or the WISC-R's apparent predictive validity with regard to academic achievement (Brooks, 1977; Dean, 1979; Hale, 1979; Wikoff, 1979), or the relative stability and remarkable similarity of the WISC-R's factor composition across age (Kaufman, 1975), sex (Reynolds & Gutkin, 1980), intellectual levels (Van Hagen & Kaufman, 1975; Karnes & Brown, 1980), and various exceptional and minority groups (Dean, 1980; Gutkin & Reynolds, 1980, 1981;

Hubble & Groff, 1981; Milich & Loney, 1979; Naglieri, 1981; Petersen & Hart, 1979; Reschley, 1978; Schooler, Beebe & Koepke, 1978). Rather, this popularity has largely come about because a number of the WISC-R's features render it particularly attractive for psychoeducational diagnostic purposes (Bush & Waugh, 1976; Saccuzzo & Lewandowski, 1976). Although designed solely as a measure of "global intelligence" or the individual's "overall capacity for intelligent behavior" (Wechsler, 1974, p.1); unlike many other instruments that yeild global IQ scores, the WISC-R was constructed with several subtests that purportedly measure a variety of skills and traits with "adequate" reliable specific variance (Dinning, 1976; Kaufman, 1980).

Based on this apparent potential to yield ability profiles, and the theoretical and pragmatic position that tests of cognitive functioning should be effected by aspects of the individual other than intellectual efficiency (Frank, 1983), it is logical to believe that different disorders ought to be mirrored in differential WISC-R performance patterns (Miller, Stoneburner & Brecht, 1978). Consequently, many clinicians and researchers have come to view the pattern of an individual's performance across WISC-R

subtests, relative to overall mean performance, as revealing of specific mental operations, cognitive processes, or brain-behavior relationships (see Kaufman, 1979a, 1980; Lutey, 1977; Sattler, 1982), and have actively promoted the utility of VIQ/PIQ discrepancy indices and performance profiles based on scaled scores, recategorized scores, or factor scores for differential diagnosis and educational planning (e.g., Banas & Wills, 1978; Bannatyne, 1971, 1974; Bush & Waugh, 1976; Kaufman, 1980; Richman & Lindgren, 1980; Vance & Singer, 1979; Wallbrown, Vance & Blaha, 1979).

This belief in the WISC-R's potential as an aid to the differential diagnosis of children has encouraged researchers to expend much time and energy in a search for subtest performance profiles characteristic of specific groups of exceptional children (eg., Clarizio & Bernard, 1981; Dean, 1977a, 1978; Eno & Woehlke, 1980; Groff & Hubble, 1981; Haynes & Bensch, 1981; Henry & Wittman, 1981; Teeter, Moore & Petersen, 1982) and a rather extensive literature has accumulated (see Berk, 1983; Dudley-Marling, Kaufman & Tarver, 1981; Engin, 1980; Kaufman, 1980, 1981; Lutey, 1977; Sattler, 1982 for an overview). But in spite of the massive research effort that has gone into differentiating exceptional groups on the basis of WISC-R subtest

profiles, the results of such studies have been less than fully consistent (see Berk, 1983; Dudley-Marling, Kaufman & Tarver, 1981; Gerken, 1978; Hale, 1983; Kaufman, 1981; Lutey, 1977; Naglieri, 1980; Sattler, 1982; Vance, Singer, Kitson & Brenner, 1983) and have failed to provide a clear picture of cognitive differences between most exceptional and normal groups, or a particularly firm basis for classification and program planning (Berk, 1983; Clarizio & Bernard, 1981; Hale, 1979; Hale & Landino, 1981; Henry & Wittman, 1981; Miller, 1980; Webster & Lafayette, 1980). While a few studies have reported positive findings, particularly for learning disabled groups, the reported profiles have been contradictory and have generally remained unverified by other researchers (Miller & Walker, 1980).

Miller (1980) suggests that this inconsistency in research findings exists because researchers who report statistically significant WISC-R patterns characteristic of specific exceptional groups, have generally failed to demonstrate that these profiles can effectively differentiate between exceptional and normal groups. The majority of studies examining the WISC-R profiles of exceptional children have simply compared intact groups of children for significant

profile differences. Most of these studies compared the WISC-R profiles of an exceptional group to the assumed "flat" profile of normal children (e.g., Dean, 1977a; Morris, Evans & Pearson, 1978; Ollendick, 1979) or directly compared the WISC-R performances of one or more groups of exceptional children (eg., Dean, 1978; Fuller & Goh, 1981). These profile studies have tended toward inconsistent results which are often attributed to differences in group composition and diagnostic criteria. As noted by Miller (1980), few studies have directly compared exceptional and normal children (e.g., Clarizio & Bernard, 1981).

A second type of profile study starts with the subtest pattern results and attempts to determine the extent to which knowledge of a child's profile will permit prediction of the child's psychoeducational diagnosis, or educational placement, or socioeconomic status. Such predictive studies have consistently found WISC-R profiles to be poor at correctly classifying children into diagnostic categories (e.g., Hale, 1979; Hale & Landino, 1981; Hale & Raymond, 1981; Webster & Lafayette, 1980; Vance, Fuller & Ellis, 1983).

A third, more recent approach, involves taking a large heterogeneous sample of children and applying a

multivariate profile analysis procedure (see Skinner & Lei, 1980) to find profiles that are characteristic of different subgroups within the sample. This approach was applied to the WISC-R by Hale and Saxe (1983) with the resultant finding of four distinct WISC-R profiles within two samples of heterogeneous clinic-referred children. However, while these profiles accurately classified 78% of the children in each sample, WISC-R profile shape added very little to simple score elevation in predicting scores on the Wide Range Achievement Test. Stepwise regression in which subtest score elevation, subtest score standard deviation, and the shape scores of each of the four modal profiles were used to predict WRAT Reading and Arithmetic subtest scores found that score elevation alone predicted between 32% and 38% of WRAT score variance. In both cases only about 8% additional variance in achievement was accounted for by knowledge of the child's WISC-R profile shape. Hale and Saxe's study gives support to the contention that certain WISC-R profiles exist which may be characteristic of subgroups of clinic-referred children but, unfortunately, does little to relate these findings to traditional psychoeducational diagnostic categories or specific patterns of classroom behavior or learning. Hale and

Saxe also failed to demonstrate that their modal profiles for clinic-referred children differ from the modal profile(s) of normal children.

In recent years, the use of the WISC-R for differential diagnosis of categories other than mental retardation has come under increasing attack on methodological grounds (see Berk, 1983; Galvin, 1981; Huelsman, 1970; Miller, 1980; Miller & Walker, 1981; Ryckman, 1981). Miller & Walker (1981) suggest that the majority of WISC-R profile studies could be seriously faulted for the lack of: normal comparison scores, or consideration of normally-expected variance in subtest scores, or consideration of variable subtest errors of measurement, or adequate specification of diagnosis. Similarly, in the light of papers on the WISC-R's psychometric properties, such as Hirshoren and Kavale's (1976) demonstration that the relatively low reliabilities of the individual WISC-R subtests preclude accurate profile analysis, a number of researchers, such as Berk (1983), argue that the application of the somewhat tentative evidence for characteristic group profiles to the classification of individuals is methodologically problematic and fraught with sources of error, and the search for diagnostically characteristic WISC-R profiles should be

abandoned as a relatively useless enterprise.

Nevertheless, in spite of the lack of consistent evidence for characteristic WISC-R profiles demonstrating diagnostic utility and the many warnings against the practice of attempting to use the WISC-R for the differential diagnosis of exceptionalities other than mental retardation, a great number of clinicians continue to proceed as if the few reported profiles were a verified fact. One possible explanation for this puzzling behavior is that the traditional research reviews that have attempted to synthesize the extensive WISC-R profile analysis literature have failed to be conclusive. Although such reviews (e.g., Dudley-Marling, Kaufman & Tarver, 1981; Huelsman, 1970; Kaufman, 1979a, 1981; Lutey, 1977; Sattler, 1982) all failed to unequivocally establish any identifying patterns, they also resulted in vague, subjective, and conjectural conclusions (Kavale & Forness, 1984). In contrast, the individual empirical studies that have reported positive findings have done so with conviction.

A somewhat different approach that has potential to unambiguously and conclusively demonstrate the existence or nonexistence of characteristic WISC-R patterns for specific groups of exceptional children

involves the application of the powerful techniques of meta-analysis (see Glass, 1976, 1977) and multivariate exploratory data analysis (see Hartwig & Dearing, 1979) to the available empirical literature. Recently, Kavale and Forness (1984) applied the techniques of meta-analysis to quantitatively synthesize the results of 94 WISC and WISC-R studies of subtest regroupings in the diagnosis of learning disabilities. Their analysis of "effect size" (see Glass, 1977) differences between the learning disabled samples and "normal" samples (or the WISC-R normative sample) across these 94 studies revealed that "...regardless of the manner in which WISC [WISC-R] subtests were grouped and regrouped, no recategorization, profile, pattern, or factor cluster emerged as a "clinically" significant indicator of LD" (Kavale & Forness, 1984, p.150). Across 94 studies, the average WISC/WISC-R profile for LD children revealed nothing extraordinary and was not unlike that of the average normal child. Kavale and Forness (1984) concluded that the WISC-R remains a valuable tool for global IQ assessment and its use use should be restricted to this purpose. While the Kavale and Forness (1984) synthesis of the WISC-R profile literature certainly came to unequivocal conclusions, it focused solely on the issue of whether there is a

characteristic LD profile and failed to examine the possibility of profiles characteristic of other diagnostic groups.

Using a somewhat different set of techniques to quantitatively synthesize research results than did Kavale and Forness, two recent studies by Mueller and his colleagues (Mueller, Dash, Matheson & Short, 1984; Mueller, Matheson, & Short, 1983) successfully applied multivariate cluster analysis and profile analysis procedures to the meta-analysis of sets of data taken from the WISC-R research literature. In the first study (Mueller, et al., 1984)', the WISC-R subtest performance patterns of 29 samples of mentally retarded (*N*=12), average intellect (*N*=11), and above average intellect (*N*=6) children drawn from the WISC-R research literature were examined. Three relatively distinct profiles emerged. One pattern was characteristic of the 12 mentally retarded samples, another was characteristic of the 11 average IQ samples, and the third was characteristic of the 6 above average IQ samples. It was suggested that WISC-R patterns may be largely a function of overall level of intellect. Similar results were obtained in a later study (Mueller, et al., 1983) examining the Bannatyne-recategorized WISC-R patterns of 36 samples

of mentally retarded, learning disabled, normal, and intellectually superior children drawn from the literature. The mentally retarded and above average IQ children showed modal profiles similar to those found in previous research while the average IQ children revealed a pattern reflecting aspects of both the mentally retarded and above average IQ samples. Of particular interest in this study was the finding that the recategorized WISC-R profiles of the learning disabled samples were not clearly distinquishable from those of normal samples of similar global intellect--results quite similar to those reported by Kavale & Forness (1984).

The present study extends this line of research to psychoeducational diagnostic groups other than the learning disabled. To determine whether there exist reliable WISC-R performance profiles characteristic of any defined group of children, multivariate cluster and profile analysis procedures were applied to the Kaufman-recategorized (1975, 1980) WISC-R data of 119 samples of children varying in mean intelligence and psychoeducational diagnosis. Although the Bannatyne (1971, 1974) method of WISC-R recategorization is likely the most popular approach to WISC-R profile analysis among clinicians, the Kaufman factor score

recategorization was used because of recent research suggesting that the Bannatyne-recategorization of the WISC-R has less diagnostic utility and validity than the scheme based on Kaufman's (1975) factor analysis of the WISC-R (Mueller, Mancini & Short, 1984; Matheson, Mueller & Short, 1984).

Method

Standard literature search procedures were utilized to locate a maximum number of research studies reporting WISC-R subtest scaled scores (for at least the 10 regular subtests) for one or more samples of children. This search yielded a total of 66 studies reporting WISC-R data for 119 samples comprising over 13,746 children of varying psychoeducational diagnoses, intellectual levels, ethno-cultural backgrounds, socioeconomic status, and both sexes. On the basis of the information available within each research report, each of the 119 samples of children was coded with reference to two broad classification dimensions: psychoeducational diagnostic code, and intellectual level code.

For assignment to a psychoeducational diagnostic code, the diagnosis given the sample in the original research report was used whenever possible. The "unimpaired" code was assigned to samples of normal

children or clinic-referred children who had been designated as being unimpaired. The "learning disabled" code was assigned only to samples that were clearly designated as having been diagnosed LD in the original research reports. Samples described as referred for suspected learning disorders, but not actually diagnosed as learning disabled, were assigned to the "clinic-referred" code. The "mentally handicapped" code was assigned to all samples clearly labelled as mentally retarded or mentally handicapped/disabled or developmentally delayed. Samples clearly identified as emotionally disturbed or emotionally handicapped/disabled were coded "emotionally disturbed" and, similarly, samples clearly designated as behavior disordered or delinquent were coded "behavior disordered". All clinic-referred samples of mixed or unspecified diagnoses were coded "clinic-referred". Lastly, all samples of impaired children not fitting into one of the above categories (eg., neurologically impaired, withdrawn, etc.) were coded "other impaired". Of the 119 samples, 23 were coded "unimpaired", 29 "learning disabled", 12 "emotionally disturbed", 5 "behavior disordered", 15 "mentally handicapped", 33 "clinic-referred", and 2 were coded "other impaired".

All samples were also coded into one of six intellectual level categories based on Wechsler's (1974) scheme. This code was based solely on the mean Full Scale IQ reported for the sample. In cases were the sample mean FSIQ was not reported, an estimate was derived from a mean of the reported subtest scaled scores. A total of 18 samples were coded as "mentally deficient", 12 as "borderline", 39 as "low average", 42 as "average", 3 as "high average", and 5 as "superior". The 119 samples used in the present analysis are referenced within Table 1 along with a description of each sample and the codes assigned.

Insert Table 1 about here

The primary data-base for analysis consisted of three recategorized scores for each sample. The sample-mean scaled scores for each of the WISC-R subtests (excluding Mazes, which was rarely reported) were combined to form the three factor groupings suggested by Kaufman's (1975) factor analysis of the WISC-R standardization data. These are: the Verbal Comprehension factor (VC) comprised of scores from the Information, Similarities, Vocabulary, and Comprehension subtests; the Perceptual Organization

factor (PO) comprised of scores from the Picture Completion, Picture Arrangement, Block Design, and Object Assembly subtests; and the Freedom from Distractibility factor (FD) comprised of scores from the Arithmetic, Digit Span, and Coding subtests (see Kaufman,1979a). The Kaufman-recategorized scores were derived by calculating the mean of the subtest scaled scores included within each category. Since a number of studies failed to report Digit Span scores, the FD score was sometimes estimated on the basis of the mean of only the Arithmetic and Coding subtests (62 samples).

The analysis of the matrix of recategorized score data proceeded through a series of discrete steps involving the empirical formation of groups of samples having similar category-score profiles, followed by multivariate tests of the differences between the score profiles of the groups of samples. The 119 samples were first partitioned into clusters of samples having similar score profiles by subjecting the data matrix to *K*-means clustering by way of the BMD: PKM program (Dixon, 1981).

The PKM procedure partitions a set of n cases or samples, each consisting of p variable scores, into k clusters using an algorithm detailed by Hartigan

(1975). At the completion of the procedure each sample belongs to the cluster whose center is closest to the sample. The square root of the sum of squares of the differences between the values of the variables for each two samples, or the Euclidean distance (D^2) (Cronbach & Gleser, 1953), is used to measure the distance between the sample and the center of each cluster. D^2 is complexly determined by components due to profile elevation, scatter, and shape-by-scatter interaction (Skinner,1978). The PKM procedure begins with all the samples in one cluster and splits one cluster into two at each step. Clustering continues until a user-specified number of clusters has been formed, at which point, any remaining unclustered samples are iteratively allocated into the cluster whose center is closest.

Analysis was performed for 2, 3, 4, 5, 6, 7, 8, and 9-cluster solutions. Since no consensus has yet been reached within the cluster analysis literature on a suitable objective methodology for determining the best cluster solution to a given clustering problem (see Everitt,1979), a modification of the "next-nearest neighbor ratio" (NNR) (see Lee & MacQueen,1980) was developed for use as a criterion for deciding at which point the formation of further clusters would not lead

to a "better" cluster solution. For each of the cluster solutions, the greatest "within-cluster" mean D^2 was divided by the smallest "between-cluster" mean D^2. This ratio becomes greater as the shortest distance between <u>any</u> two clusters becomes smaller relative to the mean distance of samples from their own cluster-center within the least homogeneous cluster. Only cluster solutions with a "within/between ratio" (W/B ratio) of .60 or less were considered "potentially adequate" solutions. For such solutions, the shortest distance between any two clusters would be at least 1.66 times as great as the greatest mean distance of any cluster's samples from their own centroid. In this manner, we define the "best" solution as that which creates the smallest number of clusters having the greatest homogenity while simultaneously maximizing the separation between clusters; without having a W/B ratio greater than .60.

Groups of samples formed empirically by the clustering procedure were subjected to a one-way multivariate analysis of variance (MANOVA) procedure (see Finn,1974; Morrison,1967). The computational program used (Hunka,1980), carries out a one-way MANOVA on k groups by p dependent variables and permits the user to input contrast matrices for special contrasts

and/or form linear combinations of dependent variables. Confidence intervals for each pair of group differences on each variable mean (including user-created variables made up of linear combinations of input variables) are calculated. Tests include Rao's approximate *F* and Heck's test. Main effects tests include a Helmert contrast matrix which is evaluated row by row. The MANOVA test for the equality of the vector of the variable means was followed by the production of simultaneous 95% confidence intervals for pairwise comparisons on each variable. A MANOVA main effects test for parallelism of the profile line-segments across groups was permitted by the creation of linear combinations of variables for each of the cluster-groups of samples. Each combination consisted of variable *p* minus variable *p*+1 (e.g., VC-PO, and PO-FD). Each combination was tested for equality across groups using simultaneous confidence intervals contrasting pairs of groups on each profile line-segment at $\alpha = .05$.

Results

Table 1 presents the source and description of the 119 samples included in the present analysis. As may be seen, the sample-mean FSIQs range from a low of 51 to a high of 140, and the selected samples represent a

fairly heterogeneous mix of children with regard to psychoeducational diagnosis.

Table 2 presents the results of the *K*-means clustering procedure for 2, 3, and 4-cluster solutions.

Insert Table 2 about here

An examination of the triangular matrices of sample-mean D^2 scores within clusters versus the mean D^2 scores between clusters across the four clustering solutions suggests the 3-cluster solution to be optimal with a W/B ratio of .38. The 4-cluster solution adds little to increased homogeneity of the clusters formed and has a W/B ratio of .76, while the 2-cluster solution demonstrates inadequate relative homogeneity for each cluster. The W/B ratios for cluster solutions above four show a rapid increase to greater than 1.00 with a 9-cluster solution.

The 3-cluster solution formed three groups comprised of 19, 75, and 25 samples respectively. Group membership, although determined by profile similarity, appears to be related more to sample-mean FSIQ than to diagnostic composition (see Table 3). The 3-cluster solution grouped all 18 of the "mentally deficient" samples, 6 of 12 "borderline" samples, and

only one of 39 "low average" samples into one group (3C); the remaining 6 "borderline" and 38 "low average", and 31 of 42 "average" samples into another group (3B); and the remaining 11 "average", 3 "high average", and 5 "superior" samples into a third group (3A). With the exception of the mentally handicapped children (cluster 3C) and the unimpaired children (cluster 3A) no clear pattern is apparent for diagnosis. Group 3A (100-140 FSIQ) is comprised of 65% of the "unimpaired" samples, 9% of the "clinic-referred" samples, and 3% of the "learning disabled" samples. This latter is a single sample of "gifted learning disabled " children. Group 3B (78-101 FSIQ) is comprised of 100% of the "behavior disordered" samples, 100% of the "other impaired" samples, 93% of the "learning disabled" samples, 92% of the "emotionally disturbed" samples, 67% of the "clinic-referred" samples, and 35% of the unimpaired samples. This group appears to contain the majority of the clinical samples included in the data-base. Group 3C (51-82 FSIQ) is comprised of 100% of the "mentally handicapped" samples, 24% of the "clinic-referred" samples, 8% of the "emotionally disturbed" samples, and 3% of the "learning disabled" samples.

Insert Table 3 about here

The 4-cluster solution formed four groups comprised of 16, 51, 33, and 19 samples respectively which, again, appear to be related more to sample-mean FSIQ differences than to diagnostic differences between samples (see Table 3). This solution basically kept intact Groups 3A and 3C defined by the 3-cluster solution, and split Group 3B into two-- a higher average IQ group and a lower average IQ group. More specifically, the 4-cluster solution grouped all 18 "mentally deficient" samples and one of the 12 "borderline" samples into one group (4D); the remaining 11 "borderline", and 20 of 39 "low average", and 2 of 42 samples into another group (4C); the remaining 19 "low average" and 32 of 42 "average" samples into another (4B); 8 "average", 3 "high average", and 5 "superior" samples into a fourth cluster (4A). Again, no clear clustering pattern is apparent on the basis of diagnostic identification of the samples. Between them, the two clustering solutions formed 7 different groupings of the 119 samples. The Kaufman category means, grand mean of the categories, and standard deviation of the category means for each of the

sample-groups defined by the 3- and 4-cluster solutions are presented in Table 4.

Insert Table 4 about here

The Kaufman-recategorized WISC-R profiles of the three sample-groups defined by the 3-cluster solution and of the four sample-groups defined by the 4-cluster solution were subjected to analysis using the MANOVA procedure described in the previous section. There was a significant multivariate main effect for profile elevation, $F(6, 230) = 64.3$; $p < .01$, when the profiles of the groups defined by the 3-cluster solution were tested simultaneously. Examination of the associated 95% confidence interval for each variable for each pair of group differences (see Table 5) reveals that Groups 3A, 3B, and 3C differ significantly from each other with regard to elevation on all three WISC-R categories.

Insert Table 5 about here

There was also a significant multivariate main effect for the three group profiles when profile line-segments were tested for parallelism, $F(4, 232) =$

11.7; p <.01. Examination of the associated 95% confidence interval for each profile line-segment for each pair of group differences (see Table 5) reveals that Group 3A differs from Group 3B in the slope of both of the line-segments defined by their 3-point performance profiles, whereas Group 3A differs from 3C in the slope of the VC-PO line-segment only. Group 3B differs from 3C only in the slope of the PO-FD line-segment. The mean VC, PO, and FD scores and standard deviations of the three sample-groups defined by the 3-cluster solution are plotted in Figure 1.

Insert Figure 1 about here

For the 4-cluster solution, there was a significant multivariate main effect for profile elevation, F (9, 278) = 57.4; p <.01, when the four profiles were tested simultaneously. Examination of the associated 95% confidence interval for each variable for each pair of group differences (see Table 5) reveals that Group 4A differs in elevation on all category scores from Groups 4B, 4C, and 4D. Similarly, Group 4B differs in elevation on all scores from Groups 4C and 4D. Group 4C, on the other hand, overlaps with 4D on PO & FD. Generally, the MANOVA for elevation

differences between the four groups does not give strong support to the separation of Groups 4C and 4D on the basis of level differences in their profiles.

There was also a significant multivariate main effect for the four group-profiles when profile line-segments were tested for parallelism, $F(6, 230) = 11.6$; $p < .01$. However, examination of the associated 95% confidence interval for each profile line-segment for each pair of group differences (see Table 5) reveals no significant differences in profile shape between Groups 4B and 4C. Similarly, Group 4A differs from Groups 4C and 4D only with regard to the slope of the VC-PO line-segment, Group 4B differs from Group 4D only in the slope of the PO-FD line-segment, and Group 4C differs from Group 4D only in the slope of the PO-FD line-segment. While the overall MANOVA for parallelism for the four-cluster solution was significant, it is clear that profiles 4B and 4C are quite similar in shape. The Kaufman-recategorized score profiles for the groups defined by the 4-cluster solution are also plotted in Figure 1.

Overall, the MANOVA results most strongly support a 3-cluster interpretation of the 119-sample data, with the resulting three profiles demonstrating significant differences in both score elevation and profile shape.

Although the mean score profile for Group 3A is VC > PO > FD, a more detailed examination of the individual profiles of the 19 samples comprising this group revealed two modal performance profiles, each accounting for 42% of the 19 clustered samples. One profile may best be described as: VC ≥ PO > FD; while the second modal profile may be described as: PO > VC ≥ FD. Fully 84% of Group 3A samples scored lowest on FD. Group 3B demonstrated a modal pattern of PO > VC ≥ FD that accounted for 75% of the 75 clustered samples. Fully 67% of the samples in this group have FD as their lowest score, and only 7% have VC as their highest.. Group 3C demonstrated a modal profile of PO > FD > VC accounting for 56% of the 25 clustered samples. No samples scored highest on the VC category, whereas fully 80% scored lowest on this category.

Lastly, an examination of cluster-group membership with respect to the ethno-cultural or sex composition of samples revealed no interpretable patterns that could be attributed to these variables, although it must be noted that many of the samples selected for analysis failed to provide an adequate sample description with respect to ethno-cultural or sex composition.

Discussion

Cluster analysis and MANOVA procedures applied to the Kaufman-recategorized WISC-R scores of 119 samples of children representing six levels of overall intellectual functioning, and seven psychoeducational diagnostic categories revealed three relatively distinct patterns of performance. One pattern appears to represent the mean performance of somewhat brighter children and suggests that such children show a strong tendency to obtain their highest scores on WISC-R subtests that tap verbal facility, and their lowest scores on subtests that tap the ability to process short-term sequential memory items and/or the ability to attend and concentrate.

A second recategorized profile appears to represent the performance pattern of upper "borderline" to lower "average" IQ children. Although the individual profiles of the 75 samples clustered into this group demonstrated rather less consistency than did the other two clusters, fully 89% of these samples scored highest on PO and 60% demonstrated a pattern of highest score on PO, second-highest score on VC, and lowest score on FD. Another 15% had VC scores that did not differ from FD. These results are quite similar to those most often reported in WISC-R profile studies of

"learning disabled" (eg., Clarizio & Bernard, 1981; Henry & Wittman, 1981; Gutkin, 1979; Raviv, et al., 1981; Smith, et al., 1977b; Webster & Lafayette, 1980) and "emotionally disturbed" (eg., Clarizio & Bernard, 1981; Henry & Wittman, 1981; Thompson, 1981; Webster & Lafayette, 1980) children. Our modal profile for lower average IQ children was also quite similar to one (#1) of the four modal profiles that Hale and Saxe (1983) reported finding in two separate samples of clinic-referred children. Such "clinical" groups of children are often of low average to lower average tested intelligence. As a group, children of intermediate intellect show the same pattern of relative strength as do the mentally handicapped, and the same pattern of relative weakness as do the intellectually superior. They show relative strength in their ability to interpret and/or organize visually perceived material and manipulate objects, and relative weakness in their ability to process short-term memory items and/or remain undistracted.

Finally, the third obtained pattern appears to represent the performance of children with low intellect. A total of 25 samples, with sample-mean FSIQs ranging from 51 to 82, were clustered together on the basis of having similar profiles. This group of

samples demonstrated relative strength on tests that tap the ability to manipulate objects perceptually, either concretely or symbolically, and relative weakness on tests that tap verbal facility.

Based on present data and analyses there does not appear to be distinctive recategorized WISC-R profiles for specific psychoeducational diagnostic groups which distinguish them from other such groups in the face of similar global intellect. Clusters of samples, grouped on the basis of profile similarity, appeared to be more similar with respect to their sample-mean FSIQ than with respect to diagnosis. Present results were quite similar to those obtained in earlier analyses involving fewer and less varied samples compared with respect to WISC-R subtest scaled scaled scores (Mueller, et al., 1984) and Bannatyne-recategorized scores (Mueller, et al., 1983). In both these previous studies profiles appeared to cluster as a function of sample-mean FSIQ.

Although the WISC-R factor structure has been shown to be relatively invariant across IQ levels (Van Hagen & Kaufman, 1975; Karnes & Brown, 1980), the relative patterning of WISC-R performance as reflected in children's Kaufman-recategorized profiles appears related in some large part to the overall level of the children's WISC-R performance as reflected in FSIQ. In

terms of a three-factor interpretation of the WISC-R, children with mild to moderate mental handicap show a distinctly different pattern of performance than do average IQ children who, in turn, demonstrate a pattern that is different from the intellectually above average. The VC category tends to shift in ranking from lowest to highest with increasing overall FSIQ, whereas the PO category tends to shift in ranking from highest to second-lowest. Similarly, the FD category tends to shift downwards from second-highest to lowest with increasing FSIQ. Any performance differences which may be related to such non-intellective sample differences as psychoeducational diagnosis cannot be clearly distinquished from the more powerful effect of intelligence level upon WISC-R patterning.

The profile differences among groups may be largely a function of the intercorrelations among WISC-R subtests. Since the groups formed by the present cluster analysis are differentiated on FSIQ, which is a composite of the 10 regular WISC-R subtests, subtests or subtest groupings that are more highly correlated with FSIQ would be expected to differentiate these groups in a similar manner. Subtest groupings with low composite correlations with FSIQ would be expected to be less successful in differentiating such

groups. Thus groups of children having extremely high FSIQs would be expected to show similarly high VC scores and low FSIQ groups would tend to demonstrate low VC scores. Scores on the FD category, having the lowest composite correlation with FSIQ, would tend to be closer to the standardized mean of 10, even when FSIQs are extreme. Groups with mean FSIQs in the average range would not be expected to exhibit a consistent profile which was based simply on patterns in the covariance matrix for subtests.

The rank of FD scores for extreme groups might also be limited by the fact that FD scores would be expected to have slightly less variance than VC or PO scores in the general population. This variance restriction is a function of the lower correlations among FD subtests, relative to correlations among the sets of variables combined to form each of VC and PO. If FD is restricted in the general population, the occurrence of a given extreme sample score for FD would be less likely than the occurrence of the same score for VC or PO. The lower internal consistency of FD is a factor in its lower correlation with FSIQ, which is a composite of the subtests comprising the Kaufman factors. (The exclusion of Digit Span from the calculation of IQs, which is the usual case, denies FD

some of the spurious covariance with FSIQ enjoyed by VC and PO.)

The results of the present meta-exploration support those researchers who have argued against the use of WISC-R profile analysis procedures for the classification of children on any basis other than intellect (e.g., Berk, 1983; Galvin, 1981; Kavale & Forness, 1984; Miller, 1980; Miller & Walker, 1981). Based on the findings of this meta-exploration, we suggest that clinicians over many years have not been entirely wrong. Distinct WISC-R performance profiles do indeed appear to exist. But, whereas WISC-R performance patterns across groups of children are certainly not random, it must be seen that they are most strongly associated with the individual's global level of intellect. The findings of this study strongly support Kavale and Forness' (1984) contention that the WISC-R should only be used for the purposes of estimating global intellectual functioning. As a diagnostic test, the WISC-R is clearly best at "diagnosing" global intellect. Certainly, it is not appropriate to assume that normal children show a flat WISC-R profile around a mean scaled score of ten and that any significant deviation from this flat profile is due to nonintellective factors and has clinical

significance.

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Table 1.

Source and Description of 119 Samples
Included in the Present Meta-Exploration.

Source	Sample Size	Mean FSIQ	Diagnosis Code	IQ Code	Description
Anderson, Kaufman & Kaufman, 1976	41	84	3	3	learning disabled, Hawaian
Brock, 1982	183	89	3	3	learning disabled, males
Brooks, 1977	15	89	2	3	clinic referred
Catron & Catron, 1977	29	60	6	1	mentally handicapped
Clarizio & Bernard, 1981	278	89	3	3	learning disabled
Clarizio & Bernard, 1981	67	90	4	4	emotionally handicapped
Clarizio & Bernard, 1981	141	69	6	1	mentally handicapped
Clarizio & Bernard, 1981	61	81	2	3	other impaired
Clarizio & Bernard, 1981	294	93	1	4	nonimpaired
Connelly, 1983	61	87	2	3	younger, Natives
Connelly, 1983	85	84	2	3	older, Natives
Dash, Dennis, Mueller, Mancini, Snart & Short, 1983	66	76	2	2	below average FSIQ
Dash, et al., 1983	81	98	2	4	average FSIQ
Dash, et al., 1983	28	121	2	6	above average FSIQ
Dean, 1977a	41	90	4	4	conduct disordered, males
Dean, 1978	60	88	4	3	emotionally disturbed
Dean, 1978	60	88	3	3	learning disabled
Dean, 1979	60	90	3	4	Anglo
Dean, 1979	60	87	3	3	Mexican-American
Eno & Woehlke, 1980	83	86	3	3	emot. disturb. & LD, males
Eno & Woehlke, 1980	37	80	3	3	emot. disturb. & LD, females
Finch, Kendall, Spirito, Entin, Montgomery & Schwartz, 1979	100	79	5	2	behavior problem
Fuller & Goh, 1981	38	86	3	3	learning disabled
Fuller & Goh, 1981	42	90	4	4	emotionally handicapped
Gironda, 1977	20	64	6	1	mental. handicap., Blacks
Gutkin & Reynolds, 1981	1868	103	1	4	normative, Whites
Gutkin & Reynolds, 1981	306	91	1	4	normative, Blacks
Hale & Landino, 1981	14	102	5	4	conduct problem, males
Hale & Landino, 1981	26	93	4	4	withdrawn, males
Hale & Landino, 1981	26	98	7	4	mixed problem, males
Hale & Landino, 1981	34	96	2	4	no problem, males

Table 1. (cont'd.)

Source	Sample Size	Mean FSIQ	Diagnosis Code	IQ Code	Description
Henry & Wittman, 1981	40	83	3	3	LD, full-time spec. educ.
Henry & Wittman, 1981	40	91	3	4	LD, resource room
Henry & Wittman, 1981	40	63	6	1	mentally handicapped
Henry & Wittman, 1981	40	88	4	3	emotionally handicapped
Henry & Wittman, 1981	40	130	1	6	gifted
Hynd, Quackenbush, Kramer, Conner & Weed, 1979	44	77	1	2	nonhandicapped, Navajo
Jensen & Reynolds, 1983	924	101	1	4	normative, White females
Karnes & Brown, 1980	946	126	1	6	gifted
Kaufman & Van Hagen, 1976	80	51	6	1	mentally handicapped
Kennedy & Elder, 1982	254	80	2	3	clinic referred, males
Kennedy & Elder, 1982	146	80	2	3	clinic referred, females
Kunce & McMahon, 1979	36	97	3	4	learning disabled, males
McMannis, Figley, Richert & Fabre, 1978	12	98	3	4	reading disabled males
McMannis, et al., 1978	12	112	1	5	normal males
Moore & Wielan, 1981	434	95	2	4	suspected reading disabilities
Morris, Evans & Pearson, 1978	71	89	4	3	emotion. handicaped, Whites
Morris, Evans & Pearson, 1978	42	82	4	3	emotion. handicaped, Blacks
Morris, Kelsey & Martin, 1980	85	82	2	3	urban
Morris, Kelsey & Martin, 1980	93	72	2	2	rural
Morris, Kelsey & Martin, 1980	114	72	2	2	Blacks
Morris, Kelsey & Martin, 1980	64	86	2	3	Whites
Morris, Kelsey & Martin, 1980	78	63	6	1	mentally handicapped
Morris, Kelsey & Martin, 1980	100	87	3	3	learning disabled
Mueller, note 1	20	62	2	1	suspected mental retard.
Munford, 1978	10	93	7	4	psychiatric, Blacks, male
Munford, 1978	10	87	7	3	psychiatric, Blacks, female
Munford, Meyerowitz & Munford, 1980	20	102	2	4	clinic referred, White
Munford, Meyerowitz & Munford, 1980	20	88	2	3	clinic referred, Black
Munford & Munoz, 1980	10	85	1	3	WISC before WISC-R
Munford & Munoz, 1980	10	102	1	4	WISC-R before WISC
Nagle & Lazarus, 1979	30	63	6	1	mentally handicapped
Ollendick, 1979	121	85	5	3	juvenile delinquent, males
Paget, 1982	42	86	4	3	conduct problem

Table 1. (cont'd.)

Source	Sample Size	Mean FSIQ	Diagnosis Code	IQ Code	Description
Peters, 1976	100	110	1	5	7-1/2 year old, Canadian
Peters, 1976	100	107	1	4	10-1/2 year old, Canadian
Peters, 1976	100	103	1	4	13-1/2 year old, Canadian
Pristo, 1978	40	98	1	4	normal students
Raviv, Margalith & Raviv, 1981	60	84	3	3	LD males, Isreali
Raviv, Margalith & Raviv, 1981	60	101	1	4	normal males, Isreali
Reschly & Davis, 1977	48	73	2	2	spec. educ. referred
Resnick, 1977	76	97	2	4	clinic referred
Rowe, 1977	44	60	6	1	mental. handicap., Australian
Saigh, 1981	20	72	6	2	mental. handicap., controls
Sandoval, 1982	332	102	1	4	normative, Anglo
Sandoval, 1982	314	92	1	4	normative, Black
Sandoval, 1982	307	94	1	4	normative, Mexican-American
Sapp, Chissom & Horton, 1984	30	82	4	3	emotionally handicapped
Sapp, Chissom & Horton, 1984	30	61	6	1	mentally retarded
Sapp, Chissom & Horton, 1984	30	93	3	4	learning disabled
Schiff, Kaufman & Kaufman, 1981	30	123	3	6	gifted LD
Schooler, Beebe & Koepke, 1978	275	88	3	3	learning disabled
Schooler, Beebe & Koepke, 1978	127	69	6	1	mentally handicapped
Schooler, Beebe & Koepke, 1978	69	90	4	4	emotionally disturbed
Schooler, Beebe & Koepke, 1978	59	80	7	3	other impaired
Schooler, Beebe & Koepke, 1978	209	92	2	4	nonimpaired
Schwarting, 1976	58	106	1	4	normal students
Seyfort, Spreen & Lahmer, 1980	177	92	1	4	Canadian Native
Smith, 1978	161	86	3	3	learning disabled
Smith, Coleman, Dokecki & Davis, 1977a	132	93	3	4	LD, higher FSIQ
Smith, et al., 1977a	76	76	3	2	LD, lower FSIQ
Solway, Fruge, Hays, Cody & Gryll, 1976	185	80	5	3	juvenile delinquent
Stokes, Brent, Huddleston, Rozier & Marrero, 1978	59	107	1	4	normal sixth-graders
Strichart & Love, 1979	40	100	2	4	suspected LD
Swerdlik, 1978	104	89	2	3	clinic referred, Whites
Swerdlik, 1978	39	80	2	3	clinic referred, Blacks
Swerdlik, 1978	21	84	2	3	clinic referred, Latinos

Table 1. (cont'd.)

Source	Sample Size	Mean FSIQ	Diagnosis Code	IQ Code	Description
Teeter, Moore & Petersen, 1982	113	79	2	2	nonhandicapped, Natives
Teeter, Moore & Petersen, 1982	189	75	4	2	emotion. disturb., Natives
Teeter, Moore & Petersen, 1982	150	70	3	2	learn. disabled, Natives
Vance, 1979	63	63	6	1	mental. handicap., males
Vance, 1979	63	63	6	1	mental. handicap., females
Vance & Engin, 1978	154	67	2	1	clinic referred, Blacks
Vance, Fuller & Ellis, 1983	67	89	5	3	behavior problem
Vance, Fuller & Ellis, 1983	68	99	3	4	learning disabled
Vance, Gaynor & Coleman, 1976	58	94	3	4	learning disabled
Vance & Hankins, 1978	176	73	2	2	clinic referred, Whites
Vance, Hankins & McGee, 1979	60	68	2	1	Appalachian, Whites
Vance, Hankins & McGee, 1979	60	68	2	1	Appalachian, Blacks
Vance, Hankins, Wallbrown, Engin & McGee, 1978	135	63	6	1	mental. handicap., males
Vance, et al., 1978	103	61	6	1	mental. handicap., females
Vance, Singer & Engin, 1980	69	96	3	4	learning disabled, males
Vance, Singer & Engin, 1980	29	97	3	4	learning disabled, females
Weiner & Kaufman, 1979	46	88	2	3	suspected LD, Black
Wersh & Briere, 1981	91	116	1	5	normal, Canadian
Wheaton & Vandergriff, 1978	26	140	1	6	gifted
Zingale & Smith, 1978	30	93	3	4	LD, low socioeconomic
Zingale & Smith, 1978	56	90	3	4	LD, middle socioeconomic
Zingale & Smith, 1978	36	84	3	3	LD, high socioeconomic

Notes: 1) Diagnosis Code-- 1 = Unimpaired, 2 = Clinic Referred, 3 = Learning Disabled, 4 = Emotionally Disturbed, 5 = Behavior Disordered, 6 = Mentally Handicapped, 7 = Other Impaired.

2) I.Q. Code-- 1 = Mentally Deficient, 2 = Borderline, 3 = Low Average, 4 = Average, 5 = High Average, 6 = Superior.

Table 2.

Clustering Data for Two, Three, and Four-Cluster Solutions.

Cluster	Samples in Cluster	Mean D^2 Distances in Standard Units Between & Within Clusters				Range of Distances from Cluster Center	Within/ Between Ratio
		1	2	3	4		
A	40	1.03	----	----	----	.26-3.66	
B	79	2.58	1.08	----	----	.17-3.23	.42
A	19	.94	----	----	----	.13-2.78	
B	75	2.51	.66	----	----	.09-1.81	
C	25	4.92	2.45	.64	----	.09-1.78	.38
A	16	.93	----	----	----	.22-2.60	
B	51	2.30	.55	----	----	.13-1.14	
C	33	3.49	1.23	.65	----	.09-1.44	
D	19	5.39	3.16	1.95	.45	.09-1.45	.76
5-Cluster solution							.82
6-Cluster solution							.76
7-Cluster solution							.78
8-Cluster solution							.85
9-Cluster solution							1.28

Table 3.

Cross-Tabulation of Samples' Cluster Membership
by Diagnosis and Intelligence Code.

	3-Clusters			4-Clusters			
	A	B	C	A	B	C	D
Diagnosis							
unimpaired	15	8	0	14	8	1	0
clinic-referred	3	22	8	1	15	13	4
learning disabled	1	27	1	1	19	9	0
emotionally disturbed	0	11	1	0	6	6	0
behavior disordered	0	5	0	0	2	3	0
mentally handicapped	0	0	15	0	0	0	15
other impaired	0	2	0	0	1	1	0
Intellectual Level							
Mentally Deficient	0	0	18	0	0	0	18
Borderline	0	6	6	0	0	11	1
Low Average	0	38	1	0	19	20	0
Average	11	31	0	8	32	2	0
High Average	3	0	0	3	0	0	0
Superior	5	0	0	5	0	0	0

Table 4.

Category Means and Standard Deviations of Sample-Groups Defined by 3 and 4-Cluster Solutions.

	3-Clusters						5-Clusters							
	Group 3a		Group 3b		Group 3c		Group 4a		Group 4b		Group 4c		Group 4d	
Category	*m*	*sd*	*m*	*sd*	*m*	*sd*	*m*	*sd*	*m*	*sd*	*m*	*sd*	*m*	*sd*
VC	11.8	2.0	7.8	1.3	4.3	0.9	12.1	2.1	8.5	1.0	6.4	0.7	4.1	1.3
PO	11.6	1.4	9.0	1.1	5.4	1.2	11.7	1.4	9.6	0.8	7.9	0.8	4.9	1.0
FD	10.8	1.2	7.5	0.7	4.9	0.9	11.1	1.0	7.9	0.6	6.8	0.8	4.5	0.6
Grand Mean	11.4	1.5	8.1	1.0	4.9	1.0	11.6	1.5	8.7	0.8	7.0	0.8	4.5	1.0

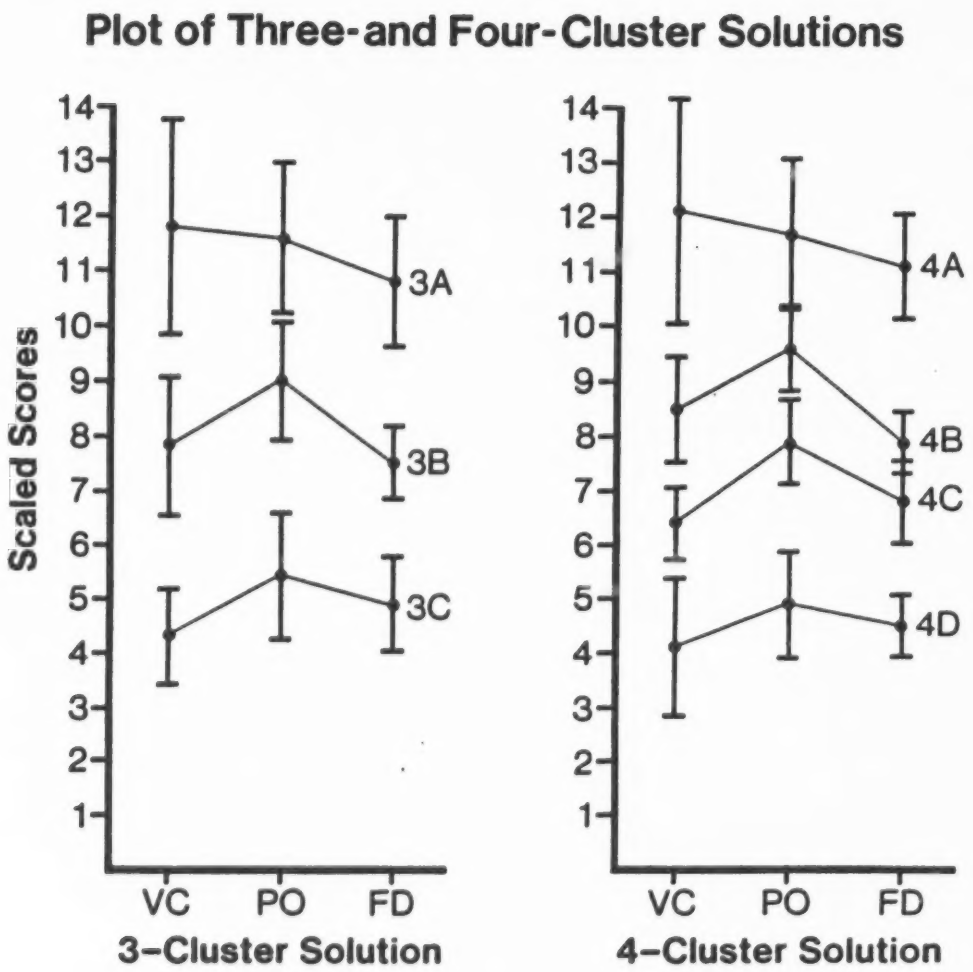
Table 5.

Significant Differences Between Groups for Elevation of Category Scores and for Category-Pair Differences (line-segments) Based on Simultaneous Confidence Intervals from MANOVA.

	Group Comparisons								
	3-Cluster Solution			4-Cluster Solution					
	3A-B	3A-C	3B-C	4A-B	4A-C	4A-D	4B-C	4B-D	4C-D
VC	*	*	*	*	*	*	*	*	*
PD	*	*	*	*	*	*	*	*	ns
FD	*	*	*	*	*	*	*	*	ns
Main effect for elevation:	$F(6, 230) = 64.3$; $p<.01$			$F(9, 278) = 57.4$; $p<.01$					
VC-PD	*	*	ns	*	*	*	ns	ns	ns
PD-FD	*	ns	*	*	ns	ns	ns	*	*
Main effect for parallelism:	$F(4, 232) = 11.7$; $p<.01$			$F(6, 230) = 11.6$; $p<.01$					

Note: An asterisk denotes significant difference at *alpha* = .05.

Figure 1


Plot of Three-and Four-Cluster Solutions
Scaled Scores
14
13
12
11
10
9
8
7
6
5
4
3
2
1
3A
3B
3C
VC
PO
FD
3-Cluster Solution
4A
4B
4C
4D
VC
PO
FD
4-Cluster Solution